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Deterioration of water quality of Surma River influenced by Natural canals passing through Sylhet City of Bangladesh

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***Abstract*—The River Surma is the most potential water source for drinking and other purposes for Sylhet. The study was conducted to assess the water quality parameters of Surma River influenced by the natural canals passing through the city to the river. Samples were collected from the estuaries of six most important canals. From the study pH was found varies from 6.17 to 7.84. DO was found very low, even nil in some canal water; Minimum average value (for whole year) of DO was detected as 2.1 mg/L in Bolram Chara. Maximum BOD_5 was detected as 6.4 mg/L and maximum average value of BOD_5 was found as 3.0 mg/L in Guali Chara. It was found that the average concentration of the pollutants in dry season (from November to February) is much higher than in wet season (March to October).**

INTRODUCTION

Sylhet City, one of the six divisional cities of Bangladesh, situated on the bank of River Surma. The river divides the city into two parts and the city is developing on the both sides. Sylhet City is suffering from a great shortage of domestic water supply. At present, water supply system of Sylhet City Corporation (SCC) is mainly dependent on ground water which fulfils only 40% of demand of its total population. The rest of the people are deprived from the water facilities of City Corporation and they mainly depend on hand pump tube wells. Unfortunately the arsenic contamination in and around the city has made the use of ground water risky for drinking purpose. Although water is being collected from the River Surma via a surface water treatment plant in Topkhana, that can meet a very little portion of the need of city people. Obviously the water quality of the River Surma is of very important concern to the water utilities to be used as an alternative source of water supply for SCC. But the water of Surma River is contaminated day by day by the direct and indirect disposal of the solid wastes, domestic and municipal sewage and agricultural run-off to the river. The city is blessed by some natural hilly canals, which are responsible for discharging the storm water to the River Surma. Unfortunately, these canals are contributing greatly in pollution of river water. Population and industrialization in Sylhet city are increasing at an alarming rate and the density of population is extremely high in and around the city area. Hence the domestic, industrial and hospital wastes, both solid and liquid, find their way into the nearest water sources e.g. the natural cannels. Moreover, the sewerage system of the city is connected with these canals. The canals, as its final destination, convey these huge wastes to the River Surma. At present, a total 180 -200 tons of solid wastes are generated in Sylhet city and only 140-160 tons are collected [3]. A study was conducted by reference [6] in 2003 to assess the water quality of River Surma. Sampling points were Kanishail (downstream of Malnichara estuary), Topkhana (downstream of Bolram Chara estuary), and Masimpur (downstream of Guali Chara estuary). It was found from the study that the highest value of Total and Dissolved Solids were 333 and 282 mg/L respectively; BOD_5 was 4.48 mg/L; Faecal Coliform was 39 N/100 ml. The minimum obtained value of Dissolved Oxygen was 1.4 mg/L, which is very threatening for the aquatic life. Surma river water was slightly acidic in dry season (6.6-7.2) and neutral in wet season (6.05-6.98). From another study [2] for water quality assessment of Malnichara, it was found that maximum value of Total Solids was in the Stadium area (600 mg/L). pH was found almost the same at every point (around 6.5); Maximum Nitrates and Chlorides were found in Subid Bazaar (0.2 mg/L) and the Stadium area (42 mg/L) respectively. From a yearlong study (from January to December 2008) of [7] for assessment of water of Guali Chara, it was found that the values for pH ranges from 7.18 to 6.6, for Total Dissolved Solids ranges from 162.75 to 328.75 mg/L, for Dissolved Oxygen from 6.24 to 5.28 mg/L, for Ammonia ranges from 0.155 to 0.3333 mg/L, Faecal Coliform ranges from 15.5 to 48.91 N/100 ml. The present year, long study was conducted for the assessment of water quality parameters of Surma River influenced by the natural canals passing through the city to the river.

STUDY AREA

Sylhet City Corporation occupies a total area of 26.5 sq. km with a population of around 0.5 million [5]. It is surrounded by some hilly areas and tea gardens from where some natural canals originated. Locally these are called as 'Chara'. Among these, Malni Chara, Jugni Chara, Mira Chara, Guali Chara, Bolram Chara, Mongoli Chara, Norsingh Chara, Kalibari Chara, Bhubi Chara, Sondha Bazar Nala, Moragang etc. are important. All these natural canals pass through the city and carry a huge quantity of storm water from the whole area to the River Surma. The water samples were collected from the estuaries of 6 important charas. These are: Kushi Khal, Guali Chara, Bolram Chara, Mongoli Chara, Malnichara and Moragang. Malnichara, originated from the Malnicherra Tea Garden, is the longest among the six. Some other small Charas (Kalibari Chara, Norsigh Chara, and Gaviar Khal) fall to Malnichara. Kushi Khal originated from Shari River, flows through eastern suburb area of SCC and falls to River Surma near Kushighat. Moragang is located at the western suburb area of SCC and falls to Surma River near Tuker Bazaar. Goali Chara originated from Lakkatura Tea Garden, passes through Baluchar, Shibgang, Sobhanii Ghat, Chalibondar, Chararpar area and falls to the River Surma at Masimpur. Some small charas like Sandabazar Chara,

Bhubi Chara, Subhanighat Chara fall to the Guali Chara. Bolram Chara and Mongoli Chara are smaller in comparison to others, but very important as they are located at the heart of the city. Bolram Chara is flowing through Jamtala, Bondar Bazaar and Taltola. One part of Bolram Chara meets with Mongoli Chara near the Mohan Market and another part falls to Surma River near Topkhana. The positions of the charas are shown in fig. - 1.

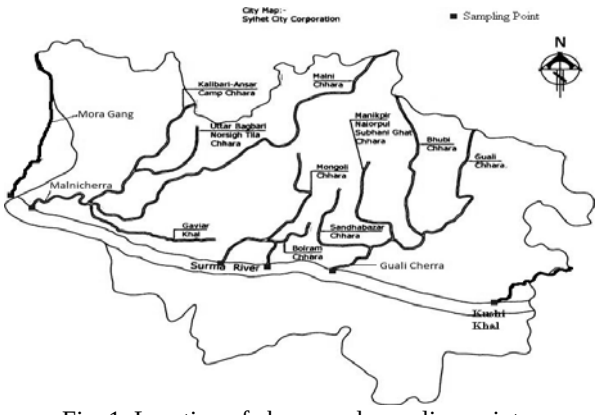

Fig. 1: Lacation of charas and sampling points.

METHODOLOGY

The water samples were collected from six different locations (at the estuaries) of the Charas. Sampling points are shown in fig. - 1. Water samples were collected at the first week of every month of a year (from March 2008 to February 2009). It was ensured that the plastic bottle used for sampling was packed by tape to make the sample free from air contact. The portable pH meter HI 8014 by HANNA Instruments was used to test pH. For Turbidity testing, Microprocessor Turbidity Meter HI 93703 by HANNA Instruments was used. PO_4, NO_3 were tested using HACH UV Spectrophotometer DR/ 4000U. Suspended Solids, Dissolved Solids, Dissolved Oxygen, BOD_5 were tested by Standard Methods developed by APHA, AWWA, WPCF (1998). All tests were performed in the Water Supply and Sewerage Engineering Laboratory, Department of Civil & Environmental Engineering, SUST, Sylhet. Two seasons were considered in the study: wet season (from March to October) and dry season (from November to February). The test results were analyzed and the maximum, minimum and average values (for whole year, wet season, and dry season) were determined.

RESULT AND DISCUSSION

A routine laboratory analysis of water quality parameters was performed for physical and chemical qualities according to Standard Methods. The study was conducted throughout a year from March 2008 to February 2009. The test result of important quality parameters, showing the seasonal fluctuation for the river presented below.

pH

Fig. 2 represents the monthly variation of pH values for all the six canals. The variations of pH at different canals are very small at different seasons. The pH value was higher in Kushi Khal and Mongoli Chara canals. In Bolram Chara pH value is lower in both dry and wet seasons. Acidic waste discharge may be the reason for lower pH in the dry season in Guali Chara and Bolram Chara as they flow through industrial areas.

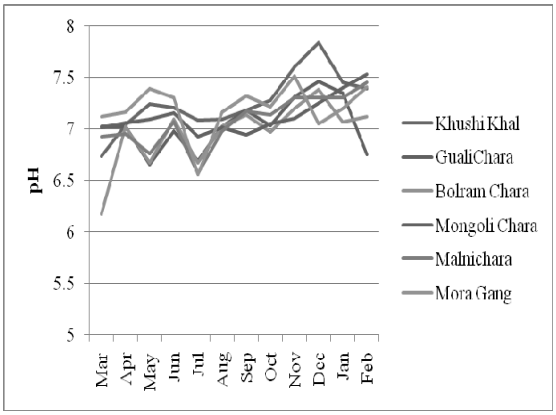

Fig. 2: pH values of various canals

Dissolve Oxygen (DO)

The test results are shown in fig. 3. Standard value for DO for sustaining aquatic life is 4 mg/L where as for drinking purposes it is 6 mg/L [1]. But DO values are found very low, even nil in some charas. The values show that all the canals, except Kushi Khal, are not suitable for aquatic life.

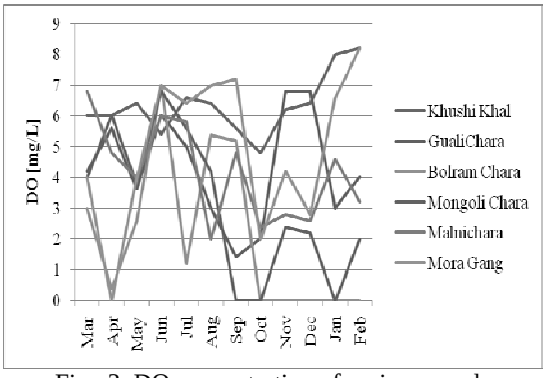

Fig. 3: DO concentration of various canals

Biochemical Oxygen Demand (BOD_5)

The BOD_5 values in Kushi Khal, Guali Chara, Bolram Chara, Mongoli Chara, Malnichara, Mora Gang tributaries were found as 5.0, 3.7, 0.0, 1.2, 2.6 and 2.8 mg/L respectively in the dry season and 1.6, 2.7, 2.3, 1.8, 2.9 and 2.3 mg/L in the wet season. For BOD_5, standard for drinking purpose is 0.2 mg/L [1]; for most of the cases water is quite unsatisfactory. The test results are shown in fig. 4.

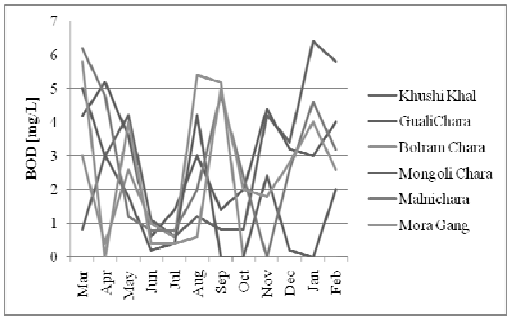

Fig. 4: BOD_5 concentration of various canals

Solid Content

The higher value of total solids contents in the canals due to the presence of large amount of silts and clay particles.

Total Solids

The test results are shown in fig. 5. The maximum concentration of Total Solids (TS) was found in Guali Chara, which is 589 mg/L. The average concentration is also the highest in this chara (320.8 mg/L).

Total Dissolved Solids

The test results are shown in fig. 6. The maximum concentration of Total Dissolved Solids (TDS) was found in Guali Chara, which is 438 mg/L. The average concentration is the highest in the Bolram Chara (194.2 mg/L).

Nitrate (NO_3)

The test results are shown in fig. 7. The highest Nitrate concentration was found in Kushi Khal, 3.7 mg/L. The average value was highest in Gualichara, 1.5 mg/L.

Phosphate (PO_4)

The test results are shown in fig. 8. The highest Phosphate concentration was found in Mongoli chara, 18 mg/L. The average value was also highest in Mongoli chara, 9.9 mg/L. In Mongoli Chara and Mora Gang, PO_4 concentration is very high and exceeds the drinking water according to Environmental Quality Standards (EQS). Industrial discharge and fertilizer residues are the respective causes of high concetration of phospahe in these charas respectiely.

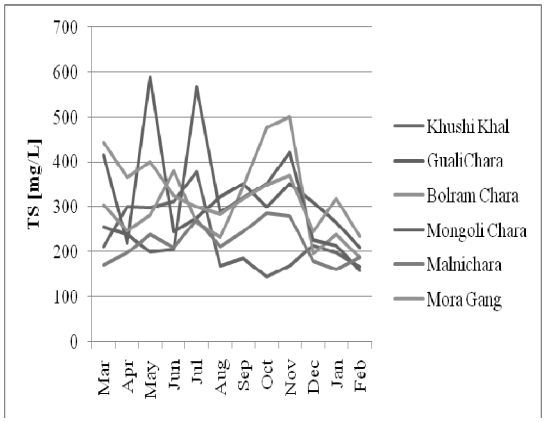

Fig. 5: TS concentration of various canals

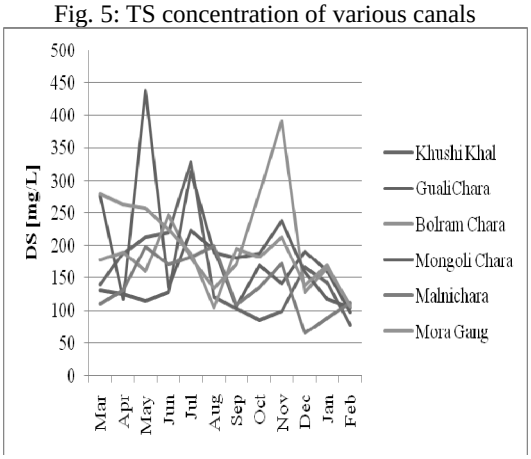

Fig. 6: TDS concentration of various canals

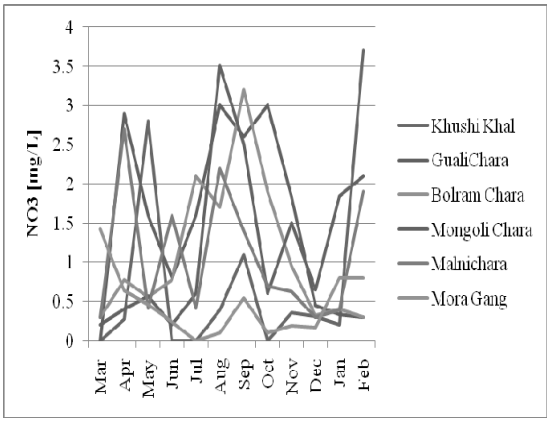

Fig. 7: NO_3 concentration of various canals

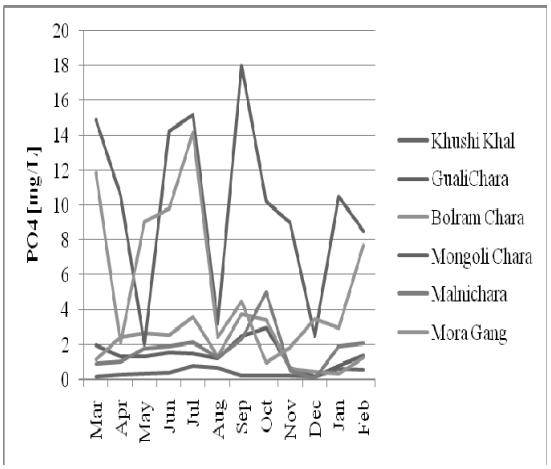

Fig. 8: PO_4 concentration of various canals

Turbidity

Turbidity is expressed in Formazin Turbidity Units (FTU). The Kushi Khal and Guali Chara canals are highly turbid in dry season but only slightly low turbid in wet season. But on other hand, in the Bolram Chara and Mora Gang are more turbid in wet season than dry season. The Turbidity in Kushi Khal, Guali Chara, Bolram Chara, Mongoli Chara, Malnichara, Mora Gang were found 137, 175, 62, 99, 68 and 103 FTU respectively in the dry season and 120, 118, 76, 59, 47 and 91 FTU in the wet season. The test results are shown in fig. 9.

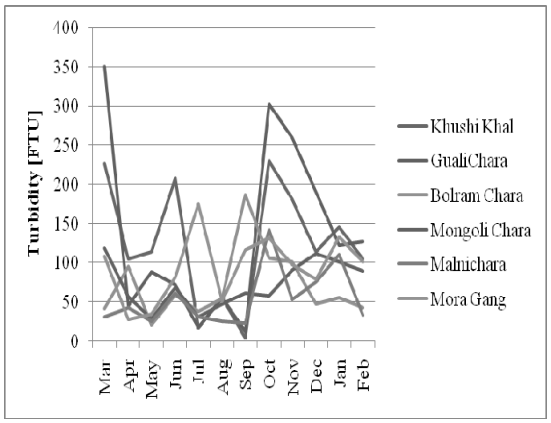

Fig. 9: Turbidity of various canals

CONCLUSION AND RECOMMENDATION

From the study it was revealed that the water quality of the charas are very far from the standards and thus this polluted water is polluting Surma River water to a great extend. From the previous works and the present work on the charas it also can be concluded that the water quality of the charas are deteriorating day by day. The main reason behind this was found as the direct connection of the sewerage network of the city with the charas. From the study pH was found varies from 6.17 to 7.84. DO was found very low, even nil in some canal water; Minimum average value (for whole year) of DO was detected as 2.1 mg/L in Bolram Chara. Maximum BOD_5 was detected as 6.4 mg/L and maximum average value (for whole year) of BOD_5 was found as 3.0 mg/L in Guali Chara. Maximum Total Solids, Dissolved Solids and Suspended Solids were found 589, 438 and 252 mg/L respectively; maximum average values (for whole year) of these parameters were 330 mg/L (Mora Gang), 194.2 mg/L (Bolram Chara) and 135.1 mg/L (Mora Gang). Maximum Turbidity was detected as 351 FTU, where as maximum average values (for whole year) of this parameter was136.8 mg/L in Guali Chara water. Maximum Nitrate and Phosphate concentration were found 3.7 and 18 mg/L respectively. Maximum average values (for whole year) of these parameters were 1.5 mg/L (Guali Chara) and 9.9 mg/L (Mongoli Chara). It was found that the average concentration of the pollutants in dry season (from November to February) is much higher than in wet season (March to October). From the study it was also revealed that, 'Guali Chara' canal is the most polluted canal. Direct discharge of sewage water to the chara (at Masim Pur and Sobhani Ghat), solid waste dumping (mainly at Subhani Ghat), direct disposal of medical wastes (from Sylhet Bokhkho Badhi Hospiltal and Sylhet Shoncramok Badhi Hospital at Baluchar and some clinics at Upashahar), open defecation near the chara (at the slums of Chalibandar and Masimpur), dumping wastes from husking mills (at Masimpur) etc. are responsible for the deterioration of the canal water [7]. Following Guali Chara canal Mongoli Chara, Moragang, Bolram Chara, Malnichara and Kushi Khal come serially according to the severity of pollution. The following recommendations can be made from the above study:

1. Protection of Surma River of Sylhet city from pollution is needed. Presently there are laws, rules and regulation but hardly there is any implementation of these laws and rules to control discharging pollutant into the river. Municipal sewer outfalls are discharging highly polluting waste waters into the river. Strict regulatory measures are needed to compel the authority to treat the waste before discharging it into the river.
2. The solid waste should not be discharged into the river and to the charas. The waste should be collected into dustbin and then to sent the treatment plant for proper treatment.
3. The sanitary waste should not be connected with chara; sewage should be conveyed with pipe system to treatment plant.
4. Hospital waste should be separated from other waste because hospital waste are harmful and spread serious diseases.
5. Public awareness about waste and its adverse impact to the general publics of the city living near chara and Surma River sides should be treated by social mobilization as well as pre-planned awareness program in the form of motivation, publicity, advertisement etc.

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